

Introduction

1. My full name is Jane Elizabeth Bowen.
2. I have been asked by the Director-General of Conservation Tumuaki Ahurei ('the D-G') to provide expert evidence on provide ecological/technical evidence on the potential effects on freshwater species and habitats of this application by Waikaka Gold Mines Limited (Applicant) to establish and operate a gold mining and processing operation on the site, with supporting ancillary activities (Application).

Qualifications and experience

3. I am employed by the Department of Conservation (DOC) as a Freshwater Technical Advisor for the National Freshwater Species Team. I have worked for DOC since August 2016 in a variety of roles including as a Community Ranger (focussing on processing RMA affected party approvals) and Senior Ranger/Supervisor Awarua Waituna Wetlands (planning and implementing the freshwater restoration programme, including a significant stream restoration project). I have also completed a secondment to The Nature Conservancy New Zealand (TNC) as Senior Conservation Advisor, leading feasibility of TNC's freshwater work programme in 2019.
4. My qualifications are a Bachelor of Science in Biological Sciences (2009) and a Postgraduate Diploma in Ecology (2013), both from the University of Canterbury, and a Masters in Environmental Management (Distinction) from Massey University (2016).
5. I have worked in my current role for five years, and as part of this role I provide advice and support on a vast range of freshwater conservation topics. I work mainly within DOC's Ngā Ika e Heke/ Freshwater Migratory Species Programme. This programme focuses on improving the security of four migratory species, including īnanga, lamprey/kanakana, longfin eel and shortjaw kōkopu. I also work within DOC's Ngā Awa/River catchment programme, which has included providing technical advice, planning and prioritising restoration opportunities, catchment wide fish passage assessments, eDNA surveys, fish surveys and īnanga spawning surveys. I have been involved in stream restoration activities, including project managing and leading the installation of the Waituna Creek restoration project, which included significant reprofiling of the bank, riparian planting and installation of large woody debris and other

habitat additions to increase ecological outcomes. In addition to this I also work within the translocation/aquatic life transfers space.

Code of Conduct

6. I confirm that I have read the code of conduct for expert witnesses as contained in clause 9 of the Environment Court's Practice Note 2023 (the Code). I have complied with the Code when preparing my written statement of evidence and will do so when I give verbal evidence before the Independent Commissioners. Although I note this is a Council hearing, I agree to comply with this code.

7. For the avoidance of doubt, in providing this evidence as an expert witness in accordance with the Code, I acknowledge that I have an overriding duty to impartially assist the Panel on matters within my area of expertise. The views expressed are my own expert views, and I do not speak on the Director-General of Conservation (DGC)'s behalf.

8. The data, information, facts and assumptions I have considered in forming my opinions are set out in my evidence to follow. The reasons for the opinions expressed are also set out in the evidence to follow. This includes, where relevant:
 - a. why other alternative interpretations of data are not supported;
 - b. any qualification, if my evidence may be incomplete or inaccurate without such qualification;
 - c. any knowledge gaps, and the potential implication of the knowledge gap;
 - d. if my opinion is not firm or concluded because of insufficient research or data or for any other reason;
 - e. an assessment of the level of confidence and the likelihood of any outcomes specified in my conclusion.

9. Unless I state otherwise, this evidence is within my sphere of expertise, and I have not omitted to consider material facts known to me that might alter or detract from the opinions that I express

Scope

10. I have been asked to provide evidence in relation to the notified consent and the DGC's submission on the potential effects on freshwater conservation values of the proposal

by Waikaka Gold Mines Limited to establish and operate a gold mining and processing operation on the site, with supporting ancillary activities.

11. My evidence addresses the following matters:
- a. Significant indigenous freshwater values of the area;
 - b. Potential adverse effects of diverting the Waikaka Stream and Shepherd's Creek;
 - c. Concerns regarding proposed restoration of Waikaka Stream and Shepherd's Creek;
 - d. Potential adverse effects of relocating and/or infilling of the Western Drain and Middle Drain;
 - e. Potential adverse effects of infilling of ponds;
 - f. Additional concerns;
 - g. Areas of agreement with the s24a report; and
 - h. Comments on proposed conditions

Material Considered

12. In preparing my evidence I have read and relied upon the following documents:
- (a) Waikaka Gold Mines Limited. (2024) Application for Resource Consent APP-20242608. As well as associated documents e.g. site plans, proposed conditions etc
 - (b) Ross Dungey Consulting Limited (2021) Attachment [L]: Addendum – Aquatic Ecology and Surface Water Quality Assessment. Prepared for Waikaka Gold Mines Limited.
 - (c) Ross Dungey Consulting Limited (2025a) Attachment [L]: Addendum – Aquatic ecology and surface water quality assessment. Prepared for Waikaka Gold Mines Limited.
 - (d) Ross Dungey Consulting Limited (2025b). Further information response – Ecology RFI response (Final). Dated April 2025.
 - (e) Hamer (2025). Council review of further information response – Freshwater ecology. Prepared for Environment Southland.

- (f) Ross Dungey Consulting Limited (2025). Further information – Ecology: Response to review questions. Prepared for Waikaka Gold Mines Limited. Dated May 2025.
- (g) All submissions received by Environment Southland on the Application
- (a) s42A Council Hearing Reports and Appendices, including the evidence of Mark Peter Hammer, Impacts of Freshwater Ecology, 5th November, 2025

Executive Summary

13. The below evidence outlines my concerns regarding the impacts on freshwater ecology of the proposed Waikaka Gold mining operation. I outline the values of the site, which are significant, due to the inclusion of species listed in the New Zealand Threat Classification System as – Threatened – Nationally Vulnerable and At Risk - Declining (Townsend et al. 2008) and the availability of habitat for these species throughout the site in the streams, creeks, ditches and ponds. I then discuss the potential adverse effects of diverting the Waikaka Stream, Shepherd's Creek, Middle Drain and associated waterways, and raise concerns about the level of detail provided for any subsequent restoration.
14. From an ecological perspective I do not support the proposed works due to the effects on habitats and freshwater species, but I provide suggested conditions, and comment on the supplied proposed conditions in the event the Commissioners are minded to grant the Application.

Context of Application and observation at site visit

15. The Applicant seeks consent to establish and operate a gold mine on a site located approximately 4 km southwest of Waikaka township, which is currently used for mixed agricultural purposes.
16. The site includes a variety of freshwater ecosystems including a section of Waikaka Stream, a section of Shepherd's Creek, and eight ponds which have varying levels of connections to other waterbodies within the site. The site also includes two drain waterways known as the Western Drain, which is connected to Waikaka Stream, and Middle Drain.
17. The Applicant proposes that to allow for gold mining operations to occur, that sections of the Waikaka Stream and Shepherd's Creek are required to be diverted into temporary channels, before the original stream bed is mined. I understand that the

stream sections will then be returned to their original alignment after one to two years. The Applicant also proposes that the Western Drain is relocated alongside Waikaka Road; that at least part of Middle Drain is infilled; and that three ponds are removed.

18. Species recorded within the site footprint, or nearby, include native freshwater fishes listed in the Freshwater Fishes New Zealand Classification (Dunn et al. 2018): Gollum galaxias (*Galaxias gollumoides*, Threatened - Nationally Vulnerable); longfin eel (*Anguilla dieffenbachii*, At Risk - Declining); shortfin eel (*Anguilla australis*, Not Threatened); upland bully (*Gobiomorphus breviceps*, Not Threatened); common bully (*Gobiomorphus cotidianus*, Not Threatened); and introduced freshwater fishes, trout (*Salmo trutta*) and perch (*Perca fluviatilis*). Koura/freshwater crayfish (*Paranephrops zealandicus*, At Risk - Declining) are also present, as well as a range of other macroinvertebrates. The species assemblages represent good diversity and include both Threatened and At Risk – Declining species
19. Out of these species, Gollum galaxias (*Galaxias gollumoides*) has the highest threat ranking (Threatened - Nationally Vulnerable). Gollum galaxias are a non-diadromous galaxiid that reside in wetlands and streams and are often found within drainage waterways and in slower margins of waterways. Gollum galaxias spawn in late spring (August-October) on cobble substrate and on submerged vegetation (Dunn et al., 2021). NIWA (2014) states that larvae and juveniles are present between September and February.
20. Gollum galaxias have been found within the proposed mining site in the western drain, as part of the surveys undertaken by Dungey (2021) where he noted extensive Gollum galaxias habitat, as well as in some of the drains connecting the ponds (Dungey, 2025c). Gollum galaxias were also found within Waikaka Stream through these surveys. Hamer (2025) has also noted that Gollum galaxias were present within Shepherd's Creek at his recent site visit. Based on this, the site in its entirety likely supports a significant habitat for Gollum galaxias. However, this Application will impact significantly on the ecological values of this site, impacting on their habitat and food supply, effects of which Gollums galaxias are highly susceptible to (NIWA, 2014).

Diversions of Shepherd's Creek and Waikaka Stream

21. I attended a site visit on the 11th November 2025. Both Shepherd's Creek and Waikaka Stream appeared to provide good instream habitat values with pool, run and riffle sequences, large woody debris, macrophytes and undercut banks. While the riparian vegetation in Waikaka Stream consisted almost entirely of exotic species such as willow and poplar, this provided extensive shading. The riparian zone in Waikaka

Stream was fenced. Shepherd's Creek was less extensively planted and therefore less shaded, and some sections were unfenced.

22. Waikaka stream is assessed by Dungey (2021) as having very high ecological values. Fish recorded in the Waikaka Stream within the site footprint include: Gollum galaxias (Threatened – Nationally Vulnerable), longfin eel (At Risk – Declining), shortfin eel (Not Threatened), upland bully (Not Threatened), brown trout and koura/freshwater crayfish (*Paranephrops zealandicus*).
23. No surveys were undertaken in Shepherd's Creek in the Applicant's ecological report, and an assessment of the values of Shepherds Creek was not carried out by Dungey (2021). However, I agree with Hamer (2025) that in the absence of this assessment and given species that are likely present, including Gollum galaxias which was observed at a site visit, that the ecological value of Shepherd's Creek is high.
24. Dungey (Aug 2024) states that 2350m of Waikaka Stream will be diverted (broken up into 4 separate diversions occurring across multiple years); and 590m of Shepherd's Creek will be diverted. I understand this will be for a time period of 1 to 2 years each, with overlap between diversions. This will represent at the least, a temporary loss of habitat, with ongoing effects should the future rehabilitation be unsuccessful.
25. There is very little research worldwide into the impacts of stream or river diversion/relocation, methods of construction and how these ultimately perform in practice (Flatley, 2018). Many international examples of river relocations have shown unintended consequences including increase in velocities, sedimentation, erosion, water quality issues, engineering failures and ecological impacts (Flatley, (2018). Neale (2025) notes several failed river realignment projects within New Zealand and states that diverting rivers into artificial channels can result in a significant loss of ecological function, loss of water through soil, loss of connectivity with groundwater and creation of eroding channels.
26. The Applicant originally proposed that no habitat would be created within the temporary diversion channels given their temporary nature. However, in my opinion, providing habitat in these temporary diversion channels is important to provide refuge and cover for fish. If no refuge and cover is provided this will reduce habitat values during the time the stream is diverted and could leave fish open to predation as they travelled through the diversion.
27. The Applicant has since agreed that some habitat could be created in the temporary diversions, and has provided for this in the attached conditions, some additional considerations are discussed below.
28. Discussions with the applicant on site indicated that diversion channels may be narrower than the original Waikaka stream with diversion widths set at approximate 5m

(N. Becker, personal communication, 5th November 2025), however Dungey (2021) notes that sections he surveyed of the Waikaka stream were on average 8.15m wide. This could represent a significant constriction of the channel. Diversions are also proposed to be shorter than the original stream length with flows suggested to grow correspondingly faster (Dungey, 2025b). This could result in an increase in velocity through the diversion channels which could potentially impact on species ability to move upstream, and/or increase erosion. To avoid this, if the Commissioners are minded to grant the Application, I would recommend that the diversion channel should have similar profiles to the original stream channel. In addition to this, the creation of instream habitat complexity may provide areas of lower velocity to aid fish to overcome any unintended velocity barriers if designed and installed correctly. It is recommended that this is considered in the context of habitat provisions in the diversion channels.

29. No shading will be provided in the diversion channels, with the Applicant stating that the short length of the diversions (500-700m long) means that temperature will be unlikely to increase as a result. However, I note that Dungey (2025b) recorded temperatures of up to 24.9°C at the site in low flow/summer conditions, with temperatures above 20°C common in the warmer months. This is already exceptionally high and of a level where any further increase in temperature may be detrimental to freshwater species at site.
30. The proposed diversion schedule shows that more than one diversion channel will be active at once, potentially compounding issues, which in my opinion could still result in localised elevated temperature despite the short length of each individual diversion channel. I also note suggestions by Hamer (2025a) of potential of shade cloth or planting of fast growing species, which should be considered further. While I acknowledge that shading would be difficult to achieve in the diversion channels, if it cannot be addressed this will remain a residual effect that needs to be off set or mitigated against.
31. I have concerns around erosion and sediment impacts as a result of this activity. Excess sediment can infill and alter habitats (including spawning, feeding and refuge habitats), enable the establishment of nuisance weeds, create anoxic conditions, and smother the feeding and gill structures of invertebrates and fish. The applicant proposes a staged approach to releasing water into the diversion channels to mitigate this, however, there is likely to be significant sediment in the first flush, and ongoing issues with sediment and erosion through the new channel as it stabilises. I am not aware of any mitigation methods that would prevent this other than what is proposed by the Applicant, which will unlikely sufficiently mitigate against this for the above discussed reasons, and therefore consider this to be a residual effect.

32. **Recommendations:** From an ecological perspective I do not support the proposal to divert Shepherd's Creek and Waikaka Stream due to the effects on habitats and freshwater species, but if the Commissioners are minded to grant the Application then I recommend significant offsetting and/or mitigation required and recommend further conditions as detailed below:
- a. I recommend that a detailed temporary diversion management plan is required, with detailed methods and designs included.
 - b. I recommend that a detailed fish management plan should be required as a condition of consent. The plan should:
 - i. Detail species at site, including critical periods such as spawning and migration and how impacts on these can be avoided or minimised.
 - ii. Detail salvage methods and handling procedures.
 - iii. Identify release sites and explain the criteria used to assess their suitability.
 - iv. Specify relevant legislation and authorisations required for translocation (Conservation Act 26ZM authorisations, Fisheries Act Special Permits etc)
 - v. Detail monitoring and reporting requirements
 - vi. Include contingency procedures, such as actions to take in the event of fish mortality or unexpected issues.
 - c. I support that the applicant has recently agreed to include habitat enhancements into the proposed diversions, however, it is recommended that there should be provision of shade incorporated into this diversion in addition to this, and consideration needs to be given to ensure the diversion channel provides velocities/flows that are appropriate.
 - d. I recommend that monitoring of each staged temporary diversion is required as a condition of consent, this is not currently within the proposed consent conditions. Monitoring should include an assessment of flows/velocity (and assessment of this against fish swimming abilities), and monitoring of any potential loss of water to ground, erosion/excessive sediment, temperature, fish presence and abundance, and assessment on how installed habitat is performing. Trigger points should be identified within the temporary diversion management plan and if issues are noted through this monitoring, these should be adequately resolved and appropriate mitigations identified for future diversions, before additional diversions are permitted to take place.

Reconstruction of Waikaka Stream and Shepherd's Creek

33. In regard to the reconstruction of Waikaka Creek and Shepherds Creek to their original alignment, post mining being completed, I do not believe that the Applicant has provided the level of detail and planning that would be required for such a large and complex stream restoration project.
34. Like Hamer (2025b), while I acknowledge that rehabilitation including recreation of riffles, pools, backwaters multiple large woody debris would be beneficial to create, I am also not aware of any successful projects that have implemented this level of restoration, at this scale.
35. I share Hamer's (2025b) concern that sufficient details on how this complex restoration would be achieved has not been provided, and his low level of confidence that this type of streambed restoration can be achieved. Having been involved in intensive stream restoration myself, albeit smaller in scale than what is proposed, in my experience a high level of planning and design (and ideally modelling) is required for successful restoration.
36. Despite Dungey's (2025c) claims that extensive design has been undertaken I have not seen evidence of this level of planning and design in the Applicant's proposed restoration work. There is only a very short section dedicated to restoration within the ecological report, containing very general information about the types of restorations which could be utilised, without committing to any specific restoration strategies, and it does not state specifically where or how they will be installed.
37. A planting plan was also supplied on 15/09/2025, but this did not provide further information on instream restoration, and there is also some general information has been provided in various other documents (e.g. basic schematic diagrams provided within additional information provided to Environment Southland in April 2025, and brief mention of provision of backwaters including a map showing potential sites which have not yet been confirmed via field inspection (Dungey, 2025a)), however, none of this is specific or detailed.
38. Given the scale of this activity and uncertainty of restoration, in my opinion, a high level of design and planning is warranted given the complex nature of this work. I note that proposed condition 36 required rehabilitation plans to be determined, however, in my view, given the scale and uncertainty of this work and the limited detail provided to date, the rehabilitation plan should be submitted prior to consent being granted. This is an integral component of the proposed activity and is necessary to assess the overall impact of it, and the appropriateness of the mitigation proposed.
39. I note that Dungey (2021) himself acknowledges the challenges of stream restoration, stating: *"It can be problematical with rehabilitation channels varying from the original*

often in subtle ways that don't always preserve the species or life stage community found in the original stream section. Subtle changes can alter the balance which is important if a species is in decline or has high conservation values"

40. **Recommendations:** From an ecological perspective I have concerns with the proposed reconstruction of Waikaka Stream and Shepherd's Creek as I do not believe that the rehabilitation has been appropriately scoped or designed, and due to concerns that reconstruction may not be successful due to the scale and complexity of this work, however, if the council is minded to grant consent I recommend the following conditions:
- a. I recommend that a complete and detailed restoration plan should be required that clearly outlines how this complex restoration will be undertaken. I recommend that the restoration should be planned and undertaken by experienced practitioner(s) which can demonstrate past experience in successful rehabilitation post stream diversion, that have resulted in good ecological outcomes, and that examples of this work would be provided to establish this experience.
 - b. Dungey (2021) notes that markers of success will be:
 - i. The same fish species present with similar size, distribution and density;
 - ii. A similar invertebrate community; and
 - iii. Maintenance of, or improvement in water quality.
 - c. Further good measures are proposed in the consent conditions, including habitat monitoring, and I support the inclusion of these. However, I recommend that proposed monitoring is carried out until the above can be demonstrated over a period of three consecutive years. I recommend this as there are always natural variations in ecological data. Ensuring that markers of success are met over consecutive years establishes a trend and helps to reduce the effects of other variables.
 - d. I strongly agree with Hamer (2025b) that a freshwater habitat restoration bond should be established and if monitoring shows that habitat restoration has been ineffective that this bond is utilised to restore the waterways further.
 - e. I recommend that diversions, instream works, and any translocation should not occur between 1 August- 31 December inclusive, so as not to disturb spawning, or the larval period of Gollums galaxias. Where fish will remain in the habitat (e.g. not translocated to alternative habitat), and spawning habitat is likely to be impacted, this period should extend to 1 April- 31 December inclusive to allow spawning habitat to regenerate. I note that Dungey (2025c) has criticised the DOC's request for exclusion into December, stating that spawning ceases at

the end of November, however, for many fish species mortality is highest during the pelagic larval stage (Jellyman & McIntosh, 2007), which is why an extended exclusion period is proposed, to avoid this sensitive life stage.

- f. Given the impacts of the activity, I believe that significant mitigation and/or setting should be required. I recommend that conditions should require improvement (net gain) not just “shall be reconstructed to achieve at least the same habitat quality and ecological values as pre-mining” as the Applicant has suggested.
- g. Dungey (2025c) states that Southland Regional Council has informed him of a willow control program within the Waikaka Stream, and he raises concerns about the loss of riparian values. This raises an opportunity for compensation, with the potential to extensively replant indigenous species along the riparian margins within the whole site footprint, using species and techniques which have already been identified for the sections proposed to be diverted once returned to original alignment. I note, however, despite this control programme, willows are still proposed to be planted. It is my recommendation that they are not, given the above rationale.

Loss of habitat in drainage ditches

- 41. Although drains are often considered only as infrastructure and have their values overlooked, they are environmentally and ecologically important (Hudson & Harding, 2004). Drains are connected to wider aquatic networks and can provide habitat for a range of freshwater species, offering refuge, spawning sites, permanent habitat and/or migration pathways, including for threatened species, particularly where natural habitats, such as wetlands, have been lost (Hudson & Harding 2004; Greer, 2021). From my own observations in Southland, waterways within the drainage network often support a high diversity and abundance of freshwater species, including providing refuge and habitat for our threatened non-diadromous species.
- 42. Dungey (2021) found longfin eel (At Risk – Declining), Gollum galaxias (Threatened – Nationally Vulnerable), and upland bully (Not Threatened) within the ditches at the proposed project site.
- 43. I note that Dungey (2021) has identified the ditches as having low value, while at the same time noting that these provide a considerable amount of galaxiid habitat, and that galaxiid larvae and adults were abundant within the ditches. I therefore dispute this assessment and instead agree with Hamer’s (2025b) assessment that these ditches

have high ecological value, and that they provide the slow-moving habitat required for both adult and juvenile Gollum galaxias habitat.

44. I visited the western drain during our recent site visit. While traditionally drains are generally dug straight, the western drain meanders slightly, which may provide some hydraulic variability and help to slow the flow, and at the sections we visited a gravel base was apparent, with extensive macrophytes/grasses present. While no intentional riparian planting was present, encroaching grasses/emergent macrophytes would provide cover, shade and refuge for small fish such as Gollums galaxias. The banks were well vegetated with grass, and stable with the bank angle/slope likely providing further shading at times. I consider that this would provide for the habitat needs of Gollum galaxias.



Figure 1- Western drain within the site footprint

45. However, despite the values and the threat status of the species present, it is proposed by the Applicant that this drain will be infilled, with an alternative drain dug alongside Waikaka Road. This drainage ditch would be entirely straight and will be devoid of

habitat until vegetation establishes. Fish salvaged from this Western Drain would then be translocated to this newly created ditch.

46. I visited the drain further upstream, outside of the project site which has recently been cleared which I was told would be similar to what the Applicant would be creating in the realigned western drain, until habitat establishes. I include a photo for reference below. Note the muddy/silty base, unstable banks, and lack of macrophyte cover, refuge and shade for fish species. While this drain had not been recently created, it had just been cleared, this is likely to share similar habitat values with a newly created drain. In a drain which had been freshly dug it would take considerable time for habitat to establish.



Figure 2- Western drain, upstream of the proposed site, post drain clearing.

47. I agree with Hamer (2025b) that translocation from established ditches to new dug out ditches which have not had the time for habitat to establish would not be an ecologically sound approach and would risk the loss of threatened species.

48. Dungey (2025c) has since stated that Gollum galaxias will be salvaged and released into alternative drains on site, however, from the original ecological assessment (Dungey, 2021) my understanding was that other drains on site are ephemeral, and had such low water levels when the ecological survey was undertaken, they could not be fished. This does not sound like an ecologically sound option as a translocation site, and I suggest that further information is required in relation to these proposed release sites.
49. I note that translocations are not without their risks, including risks to survival of species and individuals being translocated (McNeill, 2021). Dunn & O'Brien (2007) discusses only mixed success in translocations of another non-diadromous species, despite considerable effort.
50. I note that just because the fish will be translocated, does not guarantee that they will successfully establish at the new site. It will be imperative if a translocation is to take place that good quality habitat that meets the species needs is identified, evaluated, and enhanced if necessary, and that the outcomes of the translocation are monitored and reported on.
51. I also note that the Applicant has commented that they intend to connect the new western drain with the "big pond", also known as the L&M pond. There is conflicting information to date on whether or not these are already directly connected, but from GIS imagery it does not appear they are. If this is the case I recommend against this direct connection, given the presence of perch and longfin eels within this pond which are piscivorous species, both of which will prey on the Gollum galaxias within the drain.
52. Further clarification is needed in regard to the proposed outcome for Middle Drain, and how this will impact on connections within the wider freshwater system at this site.
53. **Recommendations:** I do not support the realignment and infilling of drains as detailed in the proposed consent from an ecological perspective, given the habitat and the threatened species present at site which are vulnerable to disturbance, and due to gaps in information provided which do not allow full assessment of the impacts/outcomes, however, if the Commissioners are minded to grant consent I recommend the following:
 - a. I support the recommendation of a Gollum galaxias management plan, as recommended by Hamer (2025b). As suggested by Hamer (2025b) the New Vale Coal Galaxias gollumoides management plan could be used as a template, and I recommend that as a minimum that it should include objectives agreed with stakeholders, identify threats and mitigation at site, identify and evaluate potential translocation sites (other than the newly dug drain habitat proposed) and any enhancements they may need prior to translocation, exclusion periods, ongoing maintenance requirements, and should include a

detailed on going monitoring plan, including collection of more detailed baseline information. At a minimum the management plan should be designed to ensure no net loss of Gollum galaxias and their habitat within the site, and include specific monitoring requirements to establish success, or otherwise, of proposed translocation. Note that this management plan should not only apply to the ditches/drains, but also the ponds, streams and creeks that make up the project site. This may sit alongside, or within, the previously recommended general fish management plan.

- b. As recommended for stream diversions, I recommend the following condition: That diversions, instream works, and any translocation should not occur between 1 August- 31 December inclusive, so as not to disturb spawning, or the rearing period of Gollum galaxias. Where fish will remain in the habitat (e.g. not translocated to alternative habitat), and spawning habitat is likely to be impacted, this period should extend to 1 April- 31 December inclusive to allow spawning habitat to regenerate. As previously discussed, the extension of exclusion periods until the end of December is to avoid the most sensitive life stages, and for many fish species mortality is highest during the pelagic larval stages (Jellyman & McIntosh, 2008). This condition is also recommended to apply to drains/outflow/inflows of any ponds that may also be affected.
- c. Further information is required on the levels of connections that ditches have to natural waterbodies. If relocated, it should be ensured that similar connections are made available where there would be an ecological benefit, and new connections should be avoided where there are ecological risks. These risks and benefits should be carefully evaluated in the recommended Gollum galaxias and/or wider fish management plan.

Loss of habitat in ponds

- 54. At the site visit I viewed ponds 2, 6 and 8. Ponds 2, 6 and 7 are proposed to be infilled, and while not stated in the Application, I was told at the site visit that pond 8 may also be infilled, but that this has not yet been determined (personal communication Noel Becker, 11 November 2025). Unfortunately, I have not visited pond 7, however, Dungey (2025c) notes that it supports a population of shortfin eel and has good water clarity.
- 55. Shortfin eel were also present in pond 2 and 6, but no fish were present in pond 8 when Dungey (2021) undertook his surveys. Dungey (2021) notes that it is possible that Gollum galaxias were also present in the ponds but due to methods used (fyke nets), were not captured. Effects of predation could also have impacted the results. Dungey (2025c) has since found Gollum galaxias in the drains connecting pond 6, but no further

information has been provided on intended translocation from this site. The use of eDNA may be useful to confirm presence in the other ponds (although confounding effects of other inflows would need to be taken into account).

56. I noted at my site visit that ponds 2, 6 and 8 were relatively small, appeared quite shallow and contained turbid water. Pond 2 was choked by willow but this also provided good levels of shade, ponds 6 and 8 were more open, but no significant amounts of indigenous vegetation were noted. Dungey (2021) noted “a significant short fin eel population with a range of fish sizes indicating stable habitat over several decades” within the ponds.
57. At the site visit there was uncertainty around level of connection of the ponds with connections not always immediately apparent, however, it looks like there may be varying levels of connection between these ponds, drainage ditches, and the Waikaka stream, with some permanent connections, and some connections only through flood flows. According to Dungey (2021) two ponds are permanently connected to the Waikaka Stream, and six have connection to the Waikaka Stream only during flood flows. The level of connection to the drains and other ponds is less clear.
58. Dungey (2025c) notes that the Applicant expects that a terminal pond may remain after mining activities, and that other ponds can be easily created. However, at the site visit and through other conversations I have had with the Applicant, my understanding is that the creation of a terminal pond is not at all certain, and the landowner unlikely wishes for more ponds to be created on the property. This needs to be clarified through the consent conditions, I note no mention of these ponds in the consent conditions so far.
59. These ponds represent habitat which will be permanently lost and in my opinion this loss should be assessed in the broader context of the network of streams/creeks, ditches, and ponds that species that move through these habitats at this site and utilise them for various ecological purposes.
60. **Recommendations:** I do not support the infilling of ponds as detailed in the proposed consent from an ecological perspective, due to the permanent removal of freshwater habitat, and due to gaps in information provided which do not allow full assessment of the impacts/outcomes, however, if the Commissioners are minded to grant consent I recommend the following
 - a. I recommend that further information and assessment is required on the level of connection that the ponds have with the streams, creeks and ditches, and how species use this habitat over time. This information should be utilised to fully assess the values of the site in its entirety, and if consent is granted, to inform rehabilitation efforts

- b. I recommend that use of the ponds by Gollum galaxias, suggested as a possibility in Dungey (2021), needs to be further investigated before the value of these habitats can be properly assessed. I note that Dungey (2025c) has since identified Gollum galaxias within the drains connected to pond 6). This information would provide valuable for assessment of values, translocation purposes if consent is granted, and to inform level of off setting/mitigation required.
- c. I recommend that if any further creation of ponds is intended that this is clarified, and included as condition of consent. This should include details of restoration actions, such as inclusion of indigenous plantings, variable depth, and how this will be connected with the wider freshwater network at the site.

Impacts of fords

- 61. The original Application stated that a ford would be installed. I recommend that a temporary or permanent bridge is installed as an alternative as I have concerns around sediment mobilisation due to repeated heavy vehicle crossings and the subsequent impacts on freshwater species, and depending on how the ford is constructed, there is the potential that it could impact on fish passage. Through informal conversations the Applicant has stated that they will install a bridge, however, this needs to be formalised, and I recommend that this becomes a condition of consent.

Additional concerns

- 62. I continue to have concerns around the potential impacts/risks of Potentially Acid Forming materials at site. While these concerns are outside my scope of expertise, they could have significant impacts on freshwater ecology aspects if not managed appropriately. I note that these have been addressed by Badenhop's (2025) evidence and I support these recommendations.

Areas of agreement with s42a report

- 63. I agree with the s42a report in that:
 - a. I do not consider the effects of the proposed loss of river extent and values are mitigated to achieve no residual significant adverse effects;
 - b. I too consider that that the loss of river extent and habitat values within the diversion, and the loss of habitat within the drainage ditches and ponds which are to be filled, remain as more than minor residual adverse effects, and that

there are additional measures to avoid, minimise, or remedy that have not been explored; and

- c. The proposal is uncertain in relation to several management plans that have not yet been provided and instead are proposed as conditions of consent, and the uncertainty of the content of the rehabilitation plan including lack of specific actions, timeframes and monitoring.

Comments on proposed conditions provided by applicant (in addition to proposed conditions recommended above)

64. Recommended changes to proposed condition 30:

“Works shall not be undertaken in the Waikaka Stream or Shepherd’s Creek flowing channel during the period of 1 May to 30 ~~November~~ December ~~unless a suitably qualified ecologist confirms that there are no spawning sites present in the affected reach of the stream.~~”

I recommend the above changes as it would be very difficult to definitively determine that no spawning sites were present, or that spawning would not occur over the period that works would occur . I have also changed the exclusion period through to end of December inclusive, to avoid the vulnerable larval period for Gollum galaxias, as discussed in the body of my evidence.

65. Recommended changes to condition 31:

“Works shall not be undertaken in ditches between 1 August ~~September~~ to 31 December, where these works do not result in infilling of ditches and translocation of freshwater species, this exclusion period should run from 1 April to 31 December to allow spawning habitat to regenerate prior to the spawning period.”

I recommend the above changes to be consistent with known spawning periods of Gollum galaxias. I also recommend that this period begin earlier where fish will remain in the ditches after the works, this is to give enough time for spawning vegetation and refuge to establish prior to the spawning period.

66. Recommended changes to condition 34:

“Rehabilitated reaches of the Waikaka Stream and Shepherd’s Creek shall be designed and constructed with the objective of achieving a net gain, but in any event no net loss,

in the ecological value of the rehabilitated stream reach within three years of completing the rehabilitation works. For the purposes of this condition, 'net gain' means:

- a. ~~some or~~ all of the monitoring parameters listed in condition 38 exceed the pre-mining baseline; and
- b. an independent professional ecological judgement confirming that the stream ecological value is greater than the pre-mining baseline."

Rationale: The inclusion of "some" is vague and could allow "net gain" to be demonstrated based on only a couple of the parameters, without net gain being achieved. Requiring independent professional ecological judgement removes conflict of interest or bias.

67. Recommended changes to condition 35:

"At a minimum, rehabilitated reaches shall include:

- a. a planted riparian margin at least ~~5~~ 15 metres wide on each bank comprising native species ~~and hybrid willows~~ for bank stability and provision of shade;
- b. erosion protection on outer bends sufficient to maintain channel stability and minimise sediment discharge;
- c. an approximately even distribution of pool, riffle, and run habitat types that is at least equal in number to those that were present in the original section of the channel;
- d. a cobble and gravel substrate in the low flow channel; and
- e. habitat variability, including ~~features such as~~ larger boulders, gentle meanders, and in- channel fish-shelter structures such as securely anchored large woody debris."

Rationale: The planting plan supplied to DOC allowed for planting of up to 15m wide on each bank. If the riparian planting is only to be 5m in width this would not allow sufficient space to recreate what was proposed to DOC (different zones including tall tree species). In addition to this, I consider this off setting/mitigation, and 5m is not sufficient given the impacts of the proposed activity. In my opinion, and experience, bank stability can be provided without the use of willows. Dungey (2025c) states that ES is undertaking control measures for willow within the Waikaka catchment, and this appears at odds with this. I recommend that habitat features should be created at least as many as what was present in the original channel. In addition to this (e) should be more specific- how many features, in what channels? Removing "features such as" removes subjectivity and requires the inclusion of each of these habitat features.

68. Comments on condition 36:

“Prior to diversion of any section of Waikaka Stream or Shepherds Creek, the Consent Holder shall prepare, in consultation with a suitably qualified ecologist, river engineer and Hokonui Rūnanga, a detailed design for the channel and habitat features. The detailed design shall include incorporation of any improvements identified from previous diversions. The design shall be provided to Environment Southland 20 working days prior to constructing the diversion channel, for certification that the design complies with condition 35 of this consent.”

It is recommended that given the scale of impacts of what is proposed, that this restoration plan should be developed ahead of the consent being granted. If this condition is accepted, I recommend that a mechanism is provided for DOC and other stakeholders to provide feedback prior to certification. Given the significant undertaking required here, it is suggested that more than 20 days would be required for proper assessment of this plan.

69. Comments on, and recommended edits to, condition 38:

“The consent holder shall undertake ecological monitoring of the rehabilitated stream reach a period of three years following diversion of flow back into a mined section of the Waikaka Stream or Shepherd’s Creek.

The same level of monitoring will be undertaken for any created or diverted ditches/drains, particularly the drain known as the Western Drain.

Monitoring shall be undertaken annually by a suitably qualified and experienced freshwater ecologist. The following parameters shall be monitored and reported:

- a. Habitat Quality:
 - i. Length of undercut banks
 - ii. Riparian vegetation cover
 - iii. Effective shading of the channel
 - Diversity and variability of habitat types, including the proportions and distribution of pool, riffle, and run habitats
- b. Water Quality:
 - i. Water temperature
 - ii. Total suspended solids
- c. Fish Community:
 - i. Species present
 - ii. Relative abundance
 - iii. Size distribution
- d. Macroinvertebrates:
 - i. MCI

ii. SQMCI"

70. The parameters proposed above are adequate but as discussed in the body of my evidence I recommend that proposed monitoring is carried out for 10 years post reconstruction, or until "no net loss", compared to baseline conditions, can be demonstrated over a period of three consecutive years (whichever comes first). In addition to this I note that no monitoring conditions have been proposed for the drainage ditches. I strongly recommend that this is incorporated into the conditions of the consent, and would require ongoing monitoring of Gollum galaxias populations remaining in any impacted ditches and the outcome of any translocation.

Conclusion

71. The proposed Waikaka Gold site has been shown to be ecologically significant through the presence of Threatened and At Risk – Declining species, including a population of the threatened non-diadromous galaxiid, Gollum galaxias, utilising a range of habitats throughout the site, including the stream, creek, drains, and outflow from ponds.
72. The proposed diversion of the Waikaka Stream, Shepherd's Creek and Gollum galaxias drain habitat represents a risk to a range of freshwater species, with a temporary loss of habitat, and ongoing risks should habitat rehabilitation prove unsuccessful.
73. Given the scale and complexity of this work, and the low levels of information provided to date, I have significant concerns on the adequacy of the proposed rehabilitation. I do not support the proposed activities as a result of this, but in the event that the Commissioners are minded to grant the Application I have provided a number of recommended consent conditions for the Commissioners consideration.



Jane Elizabeth Bowen

DATED this 24th day of November 2025

Appendix 1

Badenhop, A (2025). Evidence of Alexandra Macdonald Badenhop (Groundwater and Acid Mine Drainage) Dated: 13th November 2025.

Crow SK, Waters JM, Closs GP, Wallis GP. 2009. Morphological and genetic analysis of *Galaxias* 'southern' and *G. gollumoides*: interspecific differentiation and intraspecific structuring. *Journal of the Royal Society of New Zealand*. 39(2):43–62.
doi:10.1080/03014220909510563

Dungey (2021) Waikaka Goldmines Ltd Aquatic Ecology Survey. Report to Waikaka Goldmines Ltd. February 2021

Dungey, R (2025a) Waikaka Gold Review Questions, May 2025

Dungey, R (2025b). Further information response – Ecology RFI response (Final). Dated April 2025.

Dungey, R (2025c). Evidence of Ramon Ross Dungey on behalf Waikaka Gold Mines Limited, Ecology and Water Quality. 19 November 2025

Dunn, N. R., Allibone, R. M., Closs, G. P., Crow, S. K., David, B. O., Goodman, J. M., et al. (2018). Conservation status of New Zealand freshwater fishes, 2017 (New Zealand Threat Classification Series 24). Department of Conservation.
<https://www.doc.govt.nz/globalassets/documents/science-and-technical/nztcs24entire.pdf>

Dunn NR, O'Brien LK, Closs GP. 2022. Spawning strategies of *Galaxias gollumoides* McDowall and Chadderton (Gollum galaxias) from wetland and stream habitats. *Ecology of Freshwater Fish*. 31(3):529–543. doi:10.1111/eff.12648

Flatley A, Rutherford ID, Hardie R. 2018. River channel relocation: problems and prospects. *Water*. 10(10):1360. doi:10.3390/w10101360

Greer, M. (2021, December 1). Joint witness statement – Freshwater ecology memo. Environment Court, Proposed Southland Water and Land Plan. Environment Southland.

Retrieved November 19, 2025, from

<https://www.es.govt.nz/repository/libraries/id:26qi9ayo517q9stt81sd/hierarchy/about-us/plans-and-strategies/regional-plans/proposed-southland-water-and-land-plan/documents/background-documents/appeals/court-minutes-and-directions/JWS%20freshwater%20ecology%20Memo%201%20Dec%202021.pdf>

Hamer, M (2025a). Council review of further information response – Freshwater ecology. Prepared for Environment Southland

Hamer, M (2025b) Impacts of Freshwater Ecology, 5th November, 2025

Hudson, H. R., & Harding, J. S. 2004. Drainage management in New Zealand: A review of existing activities and alternative management practices (Science for Conservation No. 235). Department of Conservation. Retrieved November 19, 2025, from <https://www.doc.govt.nz/documents/science-and-technical/sfc235.pdf> [doc.govt.nz]

Jellyman, P. G., & McIntosh, A. R. 2008. The influence of habitat availability and adult density on non-diadromous galaxiid fry settlement in New Zealand. *Journal of Fish Biology*, 72(6), 1435–1446. <https://doi.org/10.1111/j.1095-8649.2007.01694.x>

MacNeil C 2021. A risk analysis framework for freshwater fish translocations. Prepared for Department of Conservation. Cawthron Report No. 3669. 36 p.

Neale M. 2025. Statement of Evidence: Freshwater Ecology (Appendix C). Environmental Protection Authority, NBEA Cambridge to Piarere Project. [accessed 2025 Nov 18]. Available from: <https://www.epa.govt.nz/assets/Uploads/Documents/Fast-track-consenting/NBEA-process/NBEA-Cambridge-to-Piarere/RFI/Appendix-C-Statement-of-Evidence-of-Dr-Martin-Neale-Freshwater-Ecology.pdf>

NIWA. 2014. Freshwater Fish Spawning and Migration Periods. NIWA Client Report prepared for Ministry for Primary Industries (Report No. HAM2014-101). National Institute of Water & Atmospheric Research Ltd. ISBN 978-0-473-32827-6. Retrieved from https://niwa.co.nz/sites/default/files/Fish_spawning_and_migration_calendar_FINAL.pdf

O'Brien L, Dunn N. 2007. Mudfish (*Neochanna Galaxiidae*) literature review. *Science for Conservation* 277. Department of Conservation, Wellington. 88 p.

Townsend, A.J.; de Lange, P.J.; Duffy, C.A.J.; Miskelley, C.M.; Molloy, J.; Norton, D.A.
2008: New Zealand threat classification system manual. Department of Conservation,
Wellington. 35 p.

